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ABSTRACT

Research findings indicate that students are affected positively or adversely by the visual, acoustical, and thermal characteristics of the classroom environment. During the 1986-87 school year, 280 fourth- and sixth-grade students housed in two separate school facilities--the oldest and the newest in a rural Tennessee county school district--were tested to determine if the physical environment of a school was related to student achievement, health, attendance, and behavior. ANOVA, chi-square, and t-tests were used to analyze the data. A significant difference existed between students at the two elementary schools in regard to the relationship between the physical environment and student achievement. Scores in reading, listening, language, and arithmetic showed a significant difference, with the students in the modern building performing much better than the students in the older school. The former students proved to have a better record in the areas of health, attendance, and discipline when compared to the latter students. Educational consultants, architects, and administrators should be apprised of the importance attached to the compatibility between physical environment and student learning and other behavior. Included are 4 tables and 10 references. (MLF)

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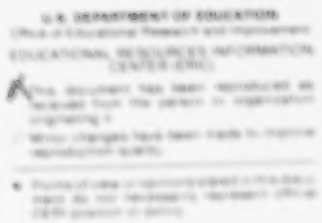
RELATIONSHIP OF STUDENT ACHIEVEMENT AND CHARACTERISTICS IN TWO SELECTED SCHOOL FACILITY ENVIRONMENTAL SETTINGS

A Paper Presented at the 64th Council of Educational Facility Planners, International Conference in Edmonton, Alberta, Canada



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RELATIONSHIP OF STUDENT ACHIEVEMENT AND CHARACTERISTICS
IN TWO SELECTED SCHOOL FACILITY ENVIRONMENTAL SETTINGS

INTRODUCTION

There is a tendency to spend a great deal of time planning for curriculum enhancement for the benefit of the student, which is well and good. However, the physical environment is assumed by most educators to be of great importance. The assumption is that students are affected positively or adversely due to visual, acoustical and thermal characteristics purposely or inadvertently built into the classroom environment.

Teachers and administrators need to be aware of the surroundings due to the seven or more hours they and their students spend in a facility each day. It seems reasonable to assume that enhancement of the physical characteristics of the learning space will improve the teacher's ability to teach and the student's ability to learn and will affect other characteristics of students such as health, attendance and discipline.

Children spend a majority of their waking hours during nine months of the year in a classroom. Some of those classrooms are clean and comfortable; others are not. Some of the classrooms have visual, acoustical, and thermal control; others do not. The intent of this research project is to determine if there is a relationship between environment as compared to learning and other characteristics.

Visual

One of the most critical physical characteristics of the classroom is lighting. Glare, inadequate illumination, too much color contrast and improper maintenance of fixtures lead to lower-than-average student performance such as misinterpretation of the written word, whether on a handout or at the chalkboard.

One outcome of the New York Academy of Science conference on the medical and biological effects of lighting, held in November, 1984, was that light is a key to the general well-being of people confined to a physical facility a great portion of the day (Hathaway & Fiedler, 1986). A completed study in Alberta, Canada, determined that trace amounts of ultraviolet radiation in classroom lighting significantly reduced the development of dental cavities and contributed to improved health. There was an apparent enhanced sense of well-being and better attendance (Wohlfarth, 1986).

Color is the most important factor contributing to acceptable lighting. Color combinations for floors, walls, and ceilings affect the lighting in a physical structure.

Johns Hopkins Institute for Cooperative Research conducted a two year study in the Baltimore schools to evaluate behavior and performance traits of 2,500 students. One school was painted conventially, the second school was recently painted and the third was painted according to directions of a paint manufacturer. The results showed that color had an effect upon student scholastic achievement and behavior. Records indicated that pupil attendance increased in the third school (Environment for Learning, 1966).

Podolosky (1938), reporting on the effects of color on the human anatomy, concluded that color combinations had an effect on a person's health and efficiency.

Acoustical

There are two kinds of sound, impact and air-borne. Installation of carpet has been a plus factor in controlling noise caused by footsteps, and acoustical materials placed in strategic areas throughout the classroom diffuse sound created by those who are conversing.

Rodman and Kunz (1966) participated in a study at Shaker High School near Albany, New York, in which the American Carpeting Institute provided 25,000

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square feet of carpet to be placed in selected spaces throughout the structure. It was determined that carpet provided acoustical control and adequate distribution of sound. The floor cover prevented multiple reflections of sound caused, in many instances, by a hard floor surface and a hard ceiling surface.

Gilliland (1970) stated that unwanted noise reduced human energy and efficiency. He concluded that the noise can affect the mental and emotional health of the teacher and student. Cohen, Sheldon and Lezak (1977) concluded that human energy and efficiency decline due to unwanted sound.

Thermal

Teachers will argue that the thermal environment is the most important of all, especially in a school plant where there is no air-conditioning. The temperature in this situation can be insufferable during a fall or spring school day. Added to the misery of the 25 or 30 students and teacher in a classroom with no cooling system is the heat emitted from their collective bodies.

Through the installation of air-conditioning equipment, those within the school environment will perform at a higher academic level. In addition, the expenditure of energy will be less.

One authority conducted a five month study to determine the physiological and psychological effects of the thermal environment on performance of workers placed in duplicate wings of a government building. One space was air conditioned and the other was not. The results showed an average work increase of 9.5 percent in the air conditioned building, an error reduction of .9 percent and an absenteeism decrease of 2.5 percent (Environment for Learning, 1966).

The New York State Commission on Ventilation determined that working in high temperatures produced physiological and psychological stress which

accelerated fatigue. Tired people work at a slower pace, exert greater effort and make more mistakes (Environment for Learning, 1966).

The comfort index strongly influences the physiological state of the student and teacher. If the temperature is 72° Farenheit, a relative humidity of 60% is acceptable. As air temperature rises, the humidity should decrease (Castaldi, 1977).

THE RESEARCH PROJECT

The newest elementary school in a selected rural Tennessee county school system presently houses 758 students, and was occupied during the 1983-1984 school year. It is located on ten acres and contains thirty-three classrooms with a student capacity of 825 students. There are three administrative offices, a conference room, teachers' workroom, twenty-four restrooms, a gymnasium, cafeteria, music room, and a well-equipped shop. The structure consists of concrete block and brick. Fluorescent lighting, electric heat and air conditioning are incorporated. The acoustics, color schemes and furniture blend into the physical environment.

The oldest school in the same school system houses 584 students. It was completed in 1939. An addition was added in 1950. Thirty-three acres serve as a campus for the school which contains two administrative offices, twenty-six classrooms, six portable classrooms, one classroom in the shop building, eight restrooms, a library, cafeteria, gymnasium, and auditorium. The student capacity for the main building is 650. Fluorescent lighting, a coal-fired furnace and several unit air conditioners are in the structure which was built with concrete, plaster, and brick. No conscious effort has been made to control the acoustics, coordinate colors and replace outdated furniture.

Both elementary schools serve grades kindergarten through eight. Each offers its instructional program within the local system framework, and the state curriculum guide as described in the 1986 Rules, Regulations and Minimum Standards of Public Schools in the State of Tennessee, pp. 20-27.

During the 1986-1987 school year, two hundred eighty fourth and sixth grade students, housed in the two separate school facilities, were tested to determine the degree of academic achievement. These students were assumed to be from somewhat similar socio-economic levels. No attempt was made to categorize each of them as such. Principals and teachers at each school were considered to be on a par with each other due to certification levels, age and experience. Here again, no effort was made to gather data as to the significance of possible differences in these variables.

THE PROBLEM

The problem was to determine if the physical environment of the school was related to student achievement, health, attendance and behavior.

Importance of the Problem

The basic premise underlying this study was that students' learning would be directly related to the physical environment of the respective facilities. It is usually accepted that the home environment of children with the better physical conditions will be more conducive to the child's overall welfare. It should follow that the same would be true in the school.

If it could be determined that there is a significant relationship between the physical environment and learning, this information should provide a basis to support arguments for funds to improve the existing facilities.

DEFINITIONS OF TERMS

Physical Environment: The aggregate of all external and internal conditions affecting the existence, growth, and welfare of organisms (Funk & Wagnalls Standard Dictionary, 1973).

Visual: Pertaining to or serving the sense of sight, perceptible by sight (Funk & Wagnalls Standard Dictionary, 1973).

Acoustical: Pertaining to sounds, with particular reference to their perception as against their production (Dictionary of Education, 1982).

Thermal Control: Pertaining to, determined by, as measured by heat (Funk & Wagnalls Standard Dictionary, 1973).

Achievement: Accomplishment or proficiency of performance in a given skill or body of knowledge (Dictionary of Education, 1982).

Discipline: The process or result of directing or subordinating immediate wishes, impulses, desires or interests for the sake of an ideal or for the purpose of gaining more effective, dependable action. Direct authoritative control of pupil behavior through punishments and rewards. (Dictionary of Education, 1982)

Health: The condition of a human organism which measures the degree to which its aggregate powers are able to function so as to bring physical, social, and emotional well being (Dictionary of Education, 1982).

Attendance: The act of being present, particularly at school. Certain court decisions have defined attendance at school as not merely being bodily present but including actual participation in the work and activities of the school. (Dictionary of Education,1982)

LIMITATIONS OF THE STUDY

The following were considered to be limitations of the study: (1) Two schools in one school system in Upper East Tennessee were used for the study. Students in grades four and six of the two schools were the subjects of the study.(2) The two schools were not selected at random. They were selected because of their age and physical environments.(3) No attempt was made to match students from one school with students with similar achievement in the other school where comparisons were made between schools.

HYPOTHESES

Research hypotheses were developed in order to test relationships between the variables.

(H1) There will be a significant difference between achievement of children in the school with a more desirable physical environment and achievement of children in the school with a less desirable physical environment.

(H2) There will be a significant difference in occurrences of discipline in the school with a more desirable physical environment as compared to occurrences of discipline in the school with a less desirable physical environment.

(H3) There will be a significant difference in the health level of students in the school with a more desirable physical environment as compared to the health level of students in the school with a less desirable physical environment.

(H4) There will be a significant difference in attendance in the school with a more desirable physical environment as compared to attendance in the school with a less desirable physical environment.

FINDINGS

The analysis of the data was performed using statistical techniques appropriate for testing the hypotheses. ANOVA, Chi-Square and t-tests were used to analyze the data and to test the hypotheses. Differences between groups for achievement and attendance were tested using ANOVA. Differences between groups concerning instances of health and discipline were tested using Chi-Square. The t-test was used for testing differences concerning attendance.

Null hypothesis 1 stated that there will be no significant difference between achievement of children in the school with a more desirable physical environment and achievement of children in the school with a less desirable physical environment. A level of .01 significance was established for rejecting the null hypothesis. The difference was tested by use of an ANOVA test. Data in Table 1 display the findings concerning this hypothesis.

Table 1

Comparison of Grades 4 and 6 student achievement between students in a modern, attractive physical environment (1) and students in an older less attractive building (2).

Subject	School	N	Mean Scores	Standard Deviations	F Ratio	Significance
		N	Mean	Standard Deviation	F	Significance
Reading	1	132	88.54	15.43	13.19	.0006
	2	127	80.94	18.40		
Listening	1	132	61.70	8.06	49.93	.0001
	2	127	53.39	10.66		
Language	1	132	77.89	13.49	12.53	.0008
	2	126	71.63	15.21		
Mathematics	1	132	91.32	18.26	35.76	.0001
	2	127	96.46	21.81		

Students in the modern building scored significantly higher in reading, listening, language and arithmetic than did students in the older building. In each instance, the difference was significant well beyond the established .01 level of acceptance. The significance level of differences for reading was .0006, for listening .0001, for language .0008 and for mathematics .0001; therefore, the null hypothesis for Hypothesis 1 was rejected.

Null Hypothesis 2 stated that there will be no significant difference in occurrences of discipline in the school with a more desirable physical environment as compared to occurrences of discipline in the school with a less desirable physical environment. Significance level established for rejecting the null hypothesis was .01. Chi-square was used for testing the difference. Data concerning the results are displayed in Table 2.

Table 2

Chi-Square Measure of Differences in Occurrences of Major Discipline Problems in a Modern Building as Compared to Occurrences in an Older Building

Label	Data
Number of Observations	280
Chi-Square	138.7
Degrees of Freedom	1
Significance Level	.0001
Contingency Coefficient	.5756

Students in the building with a more desirable physical environment were disciplined significantly less frequently than students in the building with a less desirable physical environment. The difference was far beyond the .01 acceptable level of significance, Null Hypothesis 2, therefore, was rejected.

Null Hypothesis 3 stated that there would be no significant difference in the health level of students in the school with a more desirable physical environment as compared to the health level of students in the school with a less desirable physical environment.

The Chi-Square statistical test was used to test for the significant difference. The .01 level of significance was established for rejecting the hypothesis. The resulting data are displayed in Table 3.

Table 3

Comparison of Student Health Problems in a Modern, Temperature Controlled School Building with Student Health Problems in a Less Desirable Building

Label	Data
Number of Observations	280
Chi-Square	10.41
Degrees of Freedom	1
Significance Level	.0013
Contigency Coefficient	.189

Students in the school building with a more desirable physical environment had significantly fewer major health problems than did students in the building with a less desirable physical environment. The Null Hypothesis, therefore was rejected.

Null Hypothesis 4 stated that there would be no significant difference in attendance in the school with a more desirable physical environment as compared to attendance in the school with a less desirable physical environment.

The t-test was used for the statistical treatment of the data. The .01 level of significance was established for rejecting the hypothesis. The resulting data are displayed in Table 4.

Table 4

Comparison of Student Attendance in a Modern, Temperature Controlled School Building with Student Attendance in a Less Desirable Building

N, Means, Standard Deviation, t-Value, Significance

	N	Mean	Standard Deviation	t-Value	Sifnificance
Group 1	115	175.63	4.00	3.48	.0005
Group 2	115	173.63	5.18		

Students in the school building with a more desirable physical environment had significantly higher attendance records than did students from the school where there was a building with a less desirable physical environment. The Null Hypothesis, therefore, was rejected.

Discipline

In the modern building, fourth grade boys received corporal punishment five times during the academic year as contrasted to the older building boys who were paddled fifty-four times. In addition, one boy in the older building was suspended in-school while another was suspended out-of-school. Six fourth grade girls were physically punished at the older building site.

Five sixth grade boys at the modern building were paddled during the 1986-1987 school year; twenty-six at the older school. One sixth grade girl was paddled at the modern facility and four were paddled at the older one. Also, seven boys who were sixth graders at the older building were given in-school suspension, and two boys were suspended from school.

Rationale for the use of corporal punishment at the modern school was that students exhibited conduct prejudicial to good order and discipline. The older building officials stated their reasons to be fighting, foul language, leaving

the school grounds and conduct prejudicial to good order and discipline.

Health

The county school system nurse reported to the researchers that records showed one fourth grader in the modern building contracted pneumonia during the 1986-1987 school year. Three sixth graders were stricken with strep infections.

Fourth graders at the older school contracted strep infection (4), eye infections (2) and chicken pox (2). An ear infection (1), strep infections (6), and a heart condition (1) plagued the sixth graders.

No exact numbers were available about the students at both schools who contracted flu during January of 1987. She remarked that several hundred students in both schools were affected.

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Analyzed data revealed that, in every case, a significant difference existed between students at the two elementary schools in regard to the relationship of the physical environment and student achievement. Scores in reading, listening, language and arithmetic showed a significant difference, with the modern building students performing much better than the older school students in every case.

A relationship was concluded between the physical environment and students when data were treated in the areas of health, attendance and discipline. Again, the modern school students proved to have a better record when compared to the older school students.

Students in schools where special attention has been given to the physical environment experience a greater degree of success in the academic realm of the curriculum as well as attendance, discipline and health. Educational consultants, architects and administrators should be apprised of the importance attached to the compatibility of physical environment, learning and other characteristics regarding students living in the contemporary school facility.

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